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Eric L. Prahl
Fish & Richardson P.C.
225 Franklin Street
Boston, MA 02110-2804

| EXAMINER | |
|---|---|
| LEE, SHUN K | |
| ART UNIT | PAPER NUMBER |
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DATE MAILED: 07/17/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. 09/919,511 | Applicant(s) DECK, LESLIE L. |
|---|---|---|
| | Examiner Shun Lee | Art Unit 2878 |

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *04 February 2002* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-48* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-16,27,28 and 30-48* is/are rejected.

7)☒ Claim(s) *17-26 and 29* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *16 January 2002* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *4 & 5* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

## DETAILED ACTION

### *Response to Communications*

1. The following papers have not been made part of the permanent records of the United States Patent and Trademark Office (Office) for this application (37 CFR 1.52(a)) because of damage from the United States Postal Service irradiation process:

| Mailroom Stamp Date | Certificate of Mailing Date |
| --- | --- |
| 4 February 2002 | 8 November 2001 |
| 25 February 2002 | 19 December 2001 |

The above-identified papers, however, were not so damaged as to preclude the USPTO from making a legible copy of such papers. Therefore, the Office has made a copy of these papers, substituted them for the originals in the file, and stamped that copy:

COPY OF PAPERS
ORIGINALLY FILED

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If applicant wants to review the accuracy of the Office's copy of such papers, applicant may either inspect the application (37 CFR 1.14(d)) or may request a copy of the Office's records of such papers (*i.e.*, a copy of the copy made by the Office) from the Office of Public Records for the fee specified in 37 CFR 1.19(b)(4). Please do **not** call the Technology Center's Customer Service Center to inquiry about the completeness or accuracy of Office's copy of the above-identified papers, as the Technology Center's Customer Service Center will **not** be able to provide this service.

If applicant does not consider the Office's copy of such papers to be accurate, applicant must provide a copy of the above-identified papers (except for any U.S. or

foreign patent documents submitted with the above-identified papers) with a statement that such copy is a complete and accurate copy of the originally submitted documents. If applicant provides such a copy of the above-identified papers and statement within **THREE MONTHS** of the mail date of this Office action, the Office will add the original mailroom date and use the copy provided by applicant as the permanent Office record of the above-identified papers in place of the copy made by the Office. Otherwise, the Office's copy will be used as the permanent Office record of the above-identified papers (*i.e.*, the Office will use the copy of the above-identified papers made by the Office for examination and all other purposes). This three-month period is not extendable.

***Drawings***

2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description: 105, 510, and 530. A proposed drawing correction, corrected drawings, or amendment to the specification to add the reference sign(s) in the description, are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

***Specification***

3. The disclosure is objected to because of the following informalities: in line 30 on pg. 10, "103" should probably be --121--. Appropriate correction is required.

4. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is

requested in correcting any errors of which applicant may become aware in the specification.

### *Claim Rejections - 35 USC § 103*

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 1-16, 27, 28, and 30-48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Groot (US 6,359,692) in view of Suematsu *et al.* (Applied Optics 30:4046-4055, 1991).

In regard to claims **1**, **3**, and **5-7**, the method steps are implicit for the modified apparatus of Groot since the structure is the same as the applicant's apparatus of claim 39.

In regard to claims **2** and **4** which are dependent on claim 1, the modified method of Groot comprises identifying (see lines 1-3 on right column on pg. 4048 of Suematsu *et al.*) a frequency corresponding to each of one or more selected pairs of surfaces from the frequency domain representation of the interference signal. It should be noted that cavity surfaces inherently have relative positions (see M1, M2, M3, ... ,Mn in Fig. 2 of Suematsu *et al.*) that define nominal optical path length differences $L_{mn}$ and nominal frequencies $f_{mn}$ which are calculated from the frequency tuning rate $\alpha_o$ and $L_{mn}$ (see Eq. 24 of Suematsu *et al.*) and that the identification of a frequency corresponding to each of one or more selected pairs of surfaces in a series of frequency peaks

inherently requires a comparison of the series of frequency peaks to calculated nominal frequencies.

In regard to claims **8-10** which are dependent on claim 1, the modified method of Groot lacks that the window function (*e.g.*, a Tukey window, or a Hamming window) is selected to reduce a contribution to the frequency transform at the frequency corresponding to one of the selected pairs of surfaces from at least one other pair of different surfaces in the set of cavity surfaces. Suematsu *et al.* teach (section entitled B. Three-Beam Interferometry pg. 4051-4053; Fig. 10) to isolate by filtering a frequency band corresponding to one of the selected pairs of surfaces from at least one other pair of different surfaces in the set of cavity surfaces. Therefore it would have been obvious to one having ordinary skill in the art to select the window function (*e.g.*, a Tukey window such as a Hamming or Hanning window) in the modified method of Groot, in order to isolate a frequency band corresponding to one of the selected pairs of surfaces from at least one other pair of different surfaces in the set of cavity surfaces.

In regard to claim **11** which is dependent on claim 1, Groot also discloses (column 1, lines 10-13; column 6, lines 16-18) determining the surface profile of one of the test object surfaces based on at least some of the extracted phases.

In regard to claim **12** which is dependent on claim 1, Groot also discloses (column 1, lines 10-13; column 6, lines 16-18) determining a relative optical thickness profile between two of the test object surfaces based on at least some of the extracted phases.

In regard to claims **13** and **14** which are dependent on claim 1, Groot also discloses (column 1, lines 10-13; column 6, lines 16-18) determining the surface profile of multiple ones of the test object surfaces based on at least some of the extracted phases. It should be noted that cavity surfaces inherently have relative positions (see M1, M2, M3, ... ,Mn in Fig. 2 of Suematsu *et al.*) and thus a relative orientation is inherent between two of the profiled test object surfaces. Therefore determining the surface profile of multiple ones of the test object surfaces inherently determines relative orientation.

In regard to claim **15** which is dependent on claim 1, Groot also discloses (Fig. 1) that the at least one reference surface (36) comprises one reference surface (36).

In regard to claim **16** which is dependent on claim 15, Groot also discloses (Fig. 1) that the test object (40) has a partially transparent front surface (44) and a back surface (46), the front surface (44) positioned nearer to the reference surface (36) than the back surface (46), and wherein the front, back, and reference surfaces define a three-surface cavity.

In regard to claim **27** which is dependent on claim 1, Groot also discloses (Fig. 1) positioning the test object (40) relative to the at least one reference surface (36) to cause the optical path length difference for each of the pairs of different surfaces in the set of cavity surfaces to differ.

In regard to claim **28** which is dependent on claim 27, Groot also discloses (column 8, lines 8-18) positioning the test object relative to the at least one reference surface to cause contributions to the interference signals from second order reflections

in the set of cavity surfaces to occur at frequencies that differ from the frequencies corresponding to the selected pairs of surfaces.

In regard to claims **30-32** which are dependent on claim 1, the modified method of Groot lacks monitoring the frequency tuning with a wavelength monitor comprising an interferometer and calculating the frequency transform based on the monitored frequency tuning. Suematsu *et al.* teach (section entitled A. Combination of the FFT with the Reference Technique pg. 4050-4051; Fig. 4) to monitor the frequency tuning with a wavelength monitor comprising an interferometer (*i.e.*, reference interferometer in Fig. 4) and calculating the frequency transform based on the monitored frequency tuning in order to remove the influence of unwanted variations such as nonlinear and time varying current-wavelength characteristics of a frequency-tunable light source (*i.e.*, laser diode). Therefore it would have been obvious to one having ordinary skill in the art to provide a reference interferometer in the modified method of Groot, in order to remove the influence of unwanted variations such as nonlinear and time varying current-wavelength characteristics of a frequency-tunable light source.

In regard to claims **33, 34**, and **38**, the method steps are implicit for the modified apparatus of Groot since the structure is the same as the applicant's apparatus of claim 40.

In regard to claim **35-37** which are dependent on claim 33, Groot in view of Suematsu *et al.* is applied as in claims 30-32.

In regard to claim **39**, Groot discloses (Fig. 1) an interferometry system for characterizing a test object, the system comprising:

(a) a frequency-tunable light source (22, 24);

(b) an interferometer comprising at least one reference surface (36), wherein during operation the interferometer directs different portions of an optical wave front derived from the light source (22, 24) to multiple surfaces of the test object (40) and the at least one reference surface (36) and recombines the different portions to form an optical interference image, the multiple surfaces of the test object (40) and the at least one reference surface (36) defining a set of cavity surfaces;

(c) a multi-element photo-detector (32, 33) positioned to record an interference signal at different locations of the optical interference image in response to frequency tuning of the light source (22, 24), wherein the interference signal includes a contribution from each pair of different surfaces in the set of cavity surfaces; and

(d) an electronic controller (60) coupled to the light source (22, 24) and the photo-detector (32, 33).

The interferometry system of Groot lacks that during operation the controller, for each location, calculates a frequency transform of the interference signal at a frequency corresponding to each of selected pairs of the different surfaces in the set of cavity surfaces and extracts the phase of the frequency transform at each of the frequencies corresponding to the selected pairs of surfaces. (OFDR) optical frequency domain reflectrometry is known in the art. Suematsu *et al.* teach (left column first paragraph on pg. 4047) that OFDR is used to read distance of multiple reflectors from the location of spectrum peaks appearing in the frequency spectrum of an interferometric signal and to transform the interference signal into the frequency domain (using, for example, a

Fourier transform such as a Fast Fourier transform and a window function such as a Hanning window; left column first paragraph on pg. 4051) in order to determine the phase accurately by excluding unwanted influences (the lines between Eqs. 10 and 11 in the left column on pg. 4048) and identifying (lines 1-3 on right column on pg. 4048) a frequency corresponding to each of one or more selected pairs of surfaces from the frequency domain representation of the interference signal. Groot teaches (column 6, lines 16-18) that distance h(x,y) is proportional to a phase θ(x,y) which can be determined by comparing imaginary and real part of the frequency domain representation of the interference signal at a selected frequency (Eqs. 9 and 10). Therefore it would have been obvious to one having ordinary skill in the art to provide OFDR analysis of the interferometry data in the interferometry system of Groot, in order to determine a phase and optical path distance for each of the selected pairs of surfaces.

In regard to claim **40**, Groot discloses (Fig. 1) an interferometry system for characterizing a test object, the system comprising:

(a) a frequency-tunable light source (22, 24);

(b) an interferometer comprising at least one reference surface (36), wherein during operation the interferometer directs different portions of an optical wave front derived from the light source (22, 24) to multiple surfaces of the test object (40) and the at least one reference surface (36) and recombines the different portions to form an optical interference image, the multiple surfaces of the test object (40) and the at least one reference surface (36) defining a set of cavity surfaces;

(c) a multi-element photo-detector (32, 33) positioned to record an interference signal at different locations of the optical interference image in response to frequency tuning of the light source (22, 24), wherein the interference signal includes a contribution from each pair of different surfaces in the set of cavity surfaces; and

(d) an electronic controller (60) coupled to the light source (22, 24) and the photo-detector (32, 33).

The interferometry system of Groot lacks that during operation the controller: transforms the interference signal into the frequency domain for at least one of the locations to produce a transformed signal having series of frequency peaks corresponding the pairs of different surfaces in the set of cavity surfaces; identifies a frequency corresponding to each of one or more selected pairs of surfaces from the series of frequency peaks; and determines an absolute optical thickness for each of the selected pairs of surfaces based on the corresponding identified frequency and the frequency tuning rate. (OFDR) optical frequency domain reflectrometry is known in the art. Suematsu *et al.* teach (left column first paragraph on pg. 4047) that OFDR is used to read distance of multiple reflectors from the location of spectrum peaks appearing in the frequency spectrum of an interferometric signal by transforming (see Figs. 1 and 3) the interference signal into the frequency domain for at least one of the locations to produce a transformed signal having series of frequency peaks corresponding the pairs of different surfaces in the set of cavity surfaces and identifying (lines 1-3 on right column on pg. 4048) a frequency corresponding to each of one or more selected pairs of surfaces from the series of frequency peaks so as to determine an absolute optical

thickness (L in Eq. 21) for each of the selected pairs of surfaces based on the corresponding identified frequency and the frequency tuning rate (see Eqs. 2, 6, 16-18 which defines a reference phase relative to frequency tuning rate). Therefore it would have been obvious to one having ordinary skill in the art to provide an OFDR analysis of the interferometry data in the interferometry system of Groot, in order to determine an absolute optical thickness for each of the selected pairs of surfaces.

In regard to claims **41-44**, the method steps are implicit for the modified apparatus of Groot since the structure is the same as the applicant's apparatus of claim 39.

In regard to claims **45**, **47**, and **48**, Groot in view of Suematsu *et al.* is applied as in claim 39.

In regard to claim **46** which is dependent on claim 45, Groot in view of Suematsu *et al.* is applied as in claim 12.

***Allowable Subject Matter***

7. Claims 17-26 and 29 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

8. The following is a statement of reasons for the indication of allowable subject matter: the instant application is deemed to be directed to an nonobvious improvement over the invention patented in US Patent 6,359,692. The improvement comprises in combination with other recited elements, that the test object is positioned between two reference surfaces as recited in claims 17-26 and that the test object is positioned

relative to the at least one reference surface such that the optical path lengths of successive, adjacent pairs of the cavity surfaces are substantially proportional to one another by a unique power of 3 as recited in claim 29.

### *Conclusion*

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. US Patent 6,006,128 (Izatt *et al.*) discloses (column 9, lines 51-58) it is known in the art that a choice for a window for a Fourier transform include Tukey (which encompasses the types Hamming and Hanning).

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shun Lee whose telephone number is (703) 308-4860. The examiner can normally be reached on Tuesday-Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Frank Font can be reached on (703) 308-4881. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9318 for regular communications and (703) 872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

CONSTANTINE HANNAHER
PRIMARY EXAMINER
GROUP ART UNIT 2878

SL
July 10, 2002